" CORRELATION AND PATH ANALYSIS STUDY IN CHICKPEA "

[*Cicer arietinum* (L.)]

THESIS

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS
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CERTIFICATE

I Hereby certify that the thesis entitled "**CORRELATION AND PATH ANALYSIS STUDY IN CHICK PEA** [Cicer arietinum (L)]" Submitted in Partial fulfilment of the degree of **Master of Science** in **Agriculture** (Genetics and Plant Breeding) of Bundelkhand University, Jhansi, Uttar Pradesh is a record of the banafide research work ~~carried work~~ carried out **Mr. Sunil kumar vishwakarma** (Roll No. 017252) under My Supervision and guidance.

This thesis embodies work of the condidate himself. The Condidate worked under my Supervision in the academic ~~Seasion~~ session 2001- 2002.

12.4.02

Place : Rath (Hamirpur)

(Dr. S.P. Singh)

DECLARATION

I am Sunil Kumar Vishwakarma here-by declare that the thesis tntitled *"**Correlation and Path analysis Study in chick Pea**"* [Cicer arietinum (L)]" Submitted to Bundelkhand University Jhansi (U.P.) for the award of degree of **Master of Science in Agriculture** is a result of original research work done by me.

It is further declared that the the-sis or any other there of has not been published earlier in any manner.

Place : Rath

Dated : 12|04|2002

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GLOSSARY

C.F.	=	Correction Factor
M.S.S,.	=	Mean sum of Square
S.S.	=	Sum of Square
T.S.S.	=	Total sum of Square
Treat S.S.	=	Treatment sum of Square
Repli S.S.	=	Replication sum of Square
S.P.	=	Sum of Products
T.S.P.	=	Total sum of products
M.S.P.	=	Mean sum of Products
G.T.	=	Grand total.
N.	=	Total number of observation
n.	=	Number of treatment

r.	=	Number of replication
rph.	=	Phenotypic Correlation Coefficient.
rg.	=	Genotypic Correlation Coefficient
V.R.	=	Variance ratio
X	=	Mean.
Gms.	=	Grams
Cms.	=	Centimetres.
*	=	Singificant at 5 %

CONTENTS

CHAPTER- I

INTRODUCTION

INTRODUCTION

Pulses form on important part of Indian. Vegetarian diet. Besedes being a rich source of protein, They maintain soil fertility throgh biological nitrogen fixation by bacteria prevalent in their root nodules and thus play a vital role in furthering sustainable agriculture. They are thus not depindent on industriolly fixed nitroen, a process requiring energy, but add up to 26-63 k.g.N/Ha./year to the siol and improre its fertility. The area under Pulse crops at present is around 23 million nac. The production around 5 million tonnes and Productivity about 650 k.g./ha. (2000, Hindu Survey of India agriculture).

Chickpea or gram [Cicer arietinum (h.)] this gram most improtant pulse accounting for more than a third of the area and production is about 40 percent of pulses, in this country. Dal besan (flour), Crushed or whole gram, boiled or parched roasted or cooked. salted or un salted or sweet preparations and green foliage and grain, as Vegetables, are the improtant formes in which it is consumed by the people. Germinated seeds are recommended to cure Surrey

Vanlov (1926,49) reported Hindustan as its centre of origin but the must probable place of its origin seems to be Asia minor, Particularly the cavcasus and Himalayas region.

Analysis of the whole dried seed has revealed an approximate biological compasition of maisture 9.9 percent protein, 20.8 percent fat 5.6 percent. Carbohydrates 59.8 percent fibers 1.2 percent and ash, 2.7 percent.

Although gram is cultivated over a comsidera bly large area in India the total production in very low. The magor reasons for low yield ar nonavailability of high yielding input respinsive, photoinsensitive varieties like those available in other crops. Their susceptibility to different diseases and insect pests ets. This low average yield obiviously necessitates a widely devised breeding programme which would inprove this crops qualitatively as well as quantitatively considering the improtance of gram breeding research is needed to evolve high yielding strains which will in crease the country's production, vitally needed for protein malnutretion of the vegetarians.

Yield is a product of many factors which singly or fointly influence the yield. Association of plant characters and yield. Thus aesumes special improtance as the basis of

disease in children. Malic and oxalic acids collected from green leaves are preseribed for intestinal disorders. Soaked grain and husk are fed to horses and catlle as concentrate and a roughage, respectively.

The average annual area and production are about 7-0 million hac. grown in India and production about 4-5 million tonnes pf grain respectively. Northem India accountes for hearly 90 percent of the area and about 95 percent of the production. Uttar Pradesh, Himachal Pradesh, Rajasthan and Haryana accounting for more than 6 million.

It is mainly grow under rainfed condition in the northem and north-Westrn plains of the country. India produces around 68.19 and 74.30 percent of Total production of chicpea in the world and asia respectively (FAO. 1087). Uttar Pradesh ranks second both in area and production of chickpea in the country after M.P. Its contributionin total production is 22.93 percent in total production The area Production and productivity of chickpea in U.P. is 8.22 lokh hac. 7.79 lakh matric tonnes and 8.48 q/hac.

Respectively Krishak Bharti Ravi special. U.P. 2001

According to some of the Scientists. The origin of gram is belived to be the South West Asia.

selection for desired strains the success of breeding programme is essentially a manifestation of efficiency of selection Genetics Variation in plant population is of prime concern to the breeder. The range of variability for the characters increases the scope for selection. More over. varietal evaluation with respect to yield components would also provide information as to which variety ranks high in one or more characters.

Correlation studies help in determination of the inter relationship between various plant characters. Simple correlation gives mutual association between to variables. But they do not provide
imformation about the cause and effect interrelation between yield and its components and among the components the imselves. Only path coefficient analysis depicts such couse and effect relationship. Further more, when correlation sturdies involve many traits the direct association becomes more complex. I such situation the path analysis suggested by Wright (1921) provieds an effects of association.

The path coefficient is a standarized partial regression coefficinet and as such it measures the direct influence of on variable upon another and partitioning correlation coefficient in to components of direct and in-

direct effects. Therefore correlation measures the association weith regard to cause where as the path coeffeicient analysis specifies the cause and measures of their relative importance.

Heirtability has been ased as an index of trans missibility of a character from the parent to its off spring and thas it is suitable oid to make improvement in a crop by Selection for various characters. Genetic advance also serves the some purpose. Therefore, for crop improvement by selection, as a prelude, it is essential to study the extent of genetic variability and heritability along with genetic advance.

The present investigation " Path analysis in chickpea [Cicer arietinum (L)]" was under taken to study ~~with~~ the following broad abjectives.

1- To study the genotypic and phenotypic variance.

2- To study the phenotypic and genotypic Correlation between yield and some quntitative characters.

3- To study the dircet and indirect effects of some quantitative characters on yield through path coifficient.

4- To study the heritability and genetic advaced of some quantitaive traits.

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CHAPTER - II

REVIEW OF LITERETURE

CHAPTER-II

REVIEW OF LITERATURE

A brief review of the literature on various aspets of chick-tea (Cicer arietinum L) has formed the basis of thes investigation which has been grouped under the following heads :

1. Variability (Phenotypic and Genotypic coefficients)
2. Heritabilety
3. Genetic Advance
4. Correlation coefficient (Phenotypic and Genotypic)
5. Path coefficient analysis (direct and in direct effects of the traits)

1. VARIABILITY :

Variability is the most distinctive feature of living beings and from the foundation of plant improvement. The importane of genetic variability for desease resistance and wides adabtability is well know. Moreover, the efficiency of selection in plant breeding largely depends on the exlent of the genetic variability present

in the plant population. Numerous studies have been conducted to determine the genetic variability for the reduction in genetic variability. the uniform varieties have narrow genetic base, poor adaptability and are more prone to the

new races of pathogen of compared to deverse genatypes.

A brief review of work done on the above aspects in chickpea given below :

Chand et al . (1975) reported that the highest genotypec coeffecient of variability for the number of seeds per pod was observed in a study comprising thirty genotypes.

Patil and phadnis (1977) reported that the genetic variation was highest for pods per plants pod weight per plant and 100-seed weight. All the characters varied widely except days to matusity.

Kumar et al. (1981) reported the highest coeffecient of variation for biological yield followed by grain yield and pods per plant. Kurtosis was found to be positive for biological yield and pods per plant, which indirected a preponderance of measurement near the mean. the data further revealed that coeffecients of variation were low in

case of days to flowening. plant height, length and breadth of pod and seeds per pod. the last threee characters were normally distributed. in case of days to flowering and kurtasis was positive. the study indicated the presence of appreeiable variability for biological yeild, grain yield and pods per plant.

Adhikari and pandey (1982) Studied the characters nomely, days to 50 percent flowering, plant height, number of reproductive nodes, primary and secondary branches per plant, pods per plants, 100 seed weight and seed yield per plant and reported that phenotyhpic coefficients of variation were always higher than genotypic coefficients of variation for seed yield, number of pods per plants, seed weight and secondary branches per plant.

Islam et al. (1984) Reported that the variability was wride for pods and yield per plant but norrow for days to flowering and days to maturity.

Jivani and yadvendra (1988) Reported the genotypic and phenotypic coefficient of variation for seed yield per plant and yield related traits in gine tically diverse genotypes of Bengal gram, coefficients of variation were found to be high for number of pods per plant and 100 seed weight.

Sharma et al. (1990) Observed genotypic and phenotypic coefficients of variation and reported that the highest value was shown by secondary branches per plant follwed by 100 seed weight.

Aroro (1991) Presented the analysis of variance, which revealed that mean square of genothpes were signeficant for all the characters with little diffrences in phenotypic and genotypic coefficients of variation suggesting the presence of sufficient genetic variability to allow the selection for individual traits, higher PCV and GCV valus for pods per plants, 100-seed weight and seed yeild per plant and moderately high value for plant height, primary branches per plant, secondary branches per plant and harvst in dex in dicating relatively little invironmental influence suggesting that selection for those characters could to effective.

Bhatia et al. (1993) reported that highest variability was observed for number of pods per plant.

Rao et al. (1994) Concluded that maximum variability was observed for secondary branches followed of pods per plant, 100-seed weight and seed yield per plant, Sinielarly, Rao (1994) reported that the highest coefficient of variation was observed for

seed yild per plant followed by reproductive period and 100-seed weight.

Chavan et al. (1995) revealed that genetic variability was greatest pods per plants pod weight per plant and branches per plant. low genetic variability was noted for remaining characters.

Jahagirdor et al. (1995) Reported that high genotypic and phenotypic coefficients of variations were recorded for number of pod per plant.

Tripathi (1988) Observed the high genotypic coefficient of variation for pods per plants, seeds per plant, biological yield and yield per plant indicating the pre-dominance of additive genetic variance in the expression of these traits. It is suggested that selection criteria based on plant height, biological yield and pods per plant will inprove seed yield.

Wahid and Ahmad (1999) Reported the genetic coefficients of variation to be greatest for plant height, pods, per plants and seed yield. the phenotypic coefficient of variation was greater than gentypic or invironmental coefficient of variation. It is the re fore suggeeted that plant height and pods per plant could be used as selection enrteria for further improvement.

Yadav et al. (1999) Reported that the analysis of variance

revealed considerable variability for different traits. Number of nodes, seeds per pod and seed weight were rated as stable traits and are suggested for use as selection eriteria in breeding programmes.

Kumar et al. (1999) Reported on genotypic and phenotypic coeffielents of variation is eerived from data on 7 yield-related traits in 50 chick pea genotypes from the Indian Institute of pulses Research, grown at meerut during Rabi 1994-95. Genolypic and phenotypic coefficient of 'Variation were high for number pods per plant, 100-seed weight, seed yield per plant and harvest index.

2. HERITABILITY :

The concept of heritability is important to determine whe ther the phenotypic differences observed among various in dividuals are genotical or due to the effect of invironmental factors. The heritability ex. presses the proportion of genotyhpic variation to the total variance I.e. attribuatable to the averge effect of genes, which determines the degree resemblance between relatives.

Heritability always emphasises about the selection in relation to the genetic traits. Heritability in broad

sence, provides a measures of relation ship between real or genetic variance and the obrerved phenotypic variance. Heritability in broad sense reflects the functioning of genotypes as a whole. In narrow sense it is that parts of the observed variance, which is caused by additeve genetic variance.

Gupta et al. (1972) Noted high estimates of heritability in broad sense for the number of seeds per pod and 100-seed weight.

Bharaduwaj and singh (1972) Reported high heritability estimates for all the characters except the number of seeds per pod for which it was very low. It appeared that phenotypic selection for branches per plant, pods per plant, 100-seed weight and seed yield per plant was effective for all practical purposes.

Singh et al. (1973) Reported that pod bearing length of the (destance) between first and last pod, pods per plant, 100-seed weight and seed yield per plant showed high estimates of heritability in borad sense.

Chand et al. (1975) Observed that heritability estinates were moderately high for plant height and 100-seed weight.

Setty (1977) Reported that broad sense heritability estmates were high for 100-seed weight, protein content and harvast index.

Adhikari and pandey (1982) Reported that in case of seed weight, number of pods per plant and seed yield the major part was genotypic showing high heritabilities. Although others characters such as days to flowering and seeds per pod exhibited relatively high heritabilities but the expected genetic advance due to selection was low because of narrow total variation .

Kambale et al. (1984) Observed that the pod variation per plant, dry matter production per plant, 100-seed weight and seed yield per plant gave moderate to high values for heritability.

Jivani and yadvendra (1988) Revealed high heritability estimates for plant height, days to flowering, days to maturity, plds per plant, 100-seed weight and harvest index.

Mishra et al. (1988) Reported high heritability estimates for all the charactors studied. High heritability coupled with high genetic advance was observed for number of secondary branches per plant, number of pods per plant, seed yield per plant, biological yield per plant and harvest index.

Sindhu et al. (1989) Noted that both grain yield and protein content showed high heritabilities (88.1% and 73.8% respectively).

Sharma (1990) Reported that heritebility estimates were high for days to 50 percent flowering, days to maturity, plant height, pods per plant and 100-seed weight.

Singh and Rao (1991) Noted that heritability was high for all the characters except plant spreat, pod bearing lenght and primary branches.

Rao et al. (1994) Noted that heritability estimates were found to be higher for 100-seed weight, plant height and days to flowering while rest of the charactres showed lowheritability estimates.

Jahagiradar et al. (1995) Observed high heritability estimates for 100-seed weight, days to 50 per cent flowering, number of secondary branches per plant and number of pods per plant.

Samal and Jagdev (1996) Studied the choice of character combination based on four criteria which were functions of heritability (h^2) with yield. Yield should be indicated first followed by character having higher h2 rg values.

Kumar and Krishna (1998) Reported that the grain yield showed poor heritability while first podding node, inter node length, days to 50 percent flowreing and 100-seed weight showed high heritability.

Tripathi (1998) Reported the high broad sense heritability estimates for pods per plant, seeds per plant, biological yield and yield per plant. It is Suggested that selection criteria based on plant hight, biological yield and pods per plant will in prove seed yield.

Wahid and Ahmed (1999) Reported that heritability (broad sense) was highest for plant height followed by seed yield and pods per plant.

Kumar and Sharma (1999) Reported that high heritability coupled with high genetic advance as a percentage of mean was observed for number of pods per plant, 100-seed weight. Seed yield per plant, number of pods per plant.

3. GENETIC ADVANCE :

Genetic advance is the most useful estimate as it is the improvement in the genotype in the new population over the base population. Genetic advance is directly related with

the heritability as it gives an idea about the expected genetic gain on account of selection applied for a particular trait. The difference between the mean genotypic value of the progenies of selected population and the mean genotypic value of the original base population dtermines the amount of an expected that would result from selection.

A brief review of work done on the above aspect in chickpea is given below :

Patil and Phadnis (1977) Reported that expected genetic advance was high for pods per plant, pod weight per plant, seed weight per plant and 100-seed weight.

Ram et al. (1978) Reported that seed number per plant and 100-seed weight showed genetic advance.

Adhikari and Pandey (1982) Studied the character like seed weight, number of pods and seed yield per plant and reported high genetic advance from selection. Although other characters such as days to flowering and seeds per pod exhibited the low expected genetic advance due to selection because of narno total variation.

Khorgade et al. (1985) Reported that 100-seed weight, seeds per pod, days to 50 percent flowering and branches

per plant gave high estimates of genetic advance.

Maloo and Sharma (1987) Noted high xpected genetic advance coupled with heigh heritability for seed yield., pods per plant and primary branches per plant.

Jivani and Yadvendra (1988) Reported the highest genetic gain for 100-seed weight, pods per plant and to flowering.

Sindhu and Mandal (1989) Revealed high genetic advance for seed weight.

Sharma et al. (1990) Reported the highest genetic advance for seed weight.

Sharma et al. (1990) Reported the highest genetic advance of secondry branches per plant followed by 100-seed weight.

Mishra (1991) Revealed that genetic advance was high for 100-seed weight and number of pods per plant.

Chavan et al. (1995) Reported that high genetic advance was recorded for ponds per plants and seed yield. High genetic advance coupled with high heritability for ponds per plant and seed yield indicated the importance of additive genetic variance.

Samal and Jagdev (1996) Reported that selection indices for yield were constructed and their efficiency assessed in terms of predicted genetic advanced using 24 cultivars. Four groups of indices based on 1-7 characters in cluding yield were evaluated. Efficiency of the indices over direct selection in terms of predicted genetic advance ranged from 5.4 to 101.7% the highest efficiency being for all the inclusive 7 character index. In all the four groups, the efficiency of indices increased with increasing number of characters.

Kumar and Krishna (1998) Observed genetic advance and Suggested that first podding node, inter node length and number of pods per plant were inportant yield components to select for high yield. High genetic advance was also reported for 100-seed weight.

Tripathi (1998) Reported that high genetic advance were observed for pods per plant, seeds per pod, biological yield and yield per plant. It is expected yield and pods per plant will improve seed yield.

4. CORRELATION STUDIES :

The study of correlation provides on estimates of association between the various characters.

The correlation Coefficients suggest the compunent characters on which selection can be based for substantial inprovement in yield, the data available to the plant breeder on to or more plant characteristics of a sample or a group of particular crop help einmensely in estimating to degree of association amont them. The degree of relationship is generally measured in the term of statistical correlation coefficient which varies from 1 to + 1

A brief review of work done on above aspect in chickpea is given below :

Phadhis et al. (1970) Anolysed the correlation coefficients between yield and other aronomic characters and reported that yield was highly in fluenced by seed weight followed by number of seed and number of pods plant. A negative correlation was observed between yield and plant height. These indicated that selection of dwarf plants with higher number of pods and seeds per pod con give better yield.

Khosh-Khui and Nekhecyad (1972) Observed that minimum number of genes controlling height were significantly corre-

lated with total seed wight and significantly but negatively correlated with 100-seed weight.

Gupta et al. (1972) Reported that seed yield had significant and positive phenotypic correlation with days to 50 days to 50 percent flowering primary branches, secondary branches, pods per plant and seeds per pod.

Singh et al. (1973) studeid the seed yeild which shoed a significant and positive phenotypic correlation with 100-seed weight and pod bearing length. Pod number showed singificant nigative correlation with pod bearing lenth and 100-seed weight. Pod bearing length was positively correlatdd with 100-seed weigth.

Khan et al. (1975) reported yield to be positively correlated with plant height, number of primary branches secondary and tirtlary branches and number of pods per plant.Negative correlations were observed between yield, number of seeds per pod and seed size. there were strong positive genetic correlations between yield and all the other traits studeid except seed size.

Bahl et al. (1976) observed that seed yield per plant had significant positive correlations with number of posds per

plant and 100-seed weight. Number of Branches were significantly and positively correlated with pods number per plant. Seeds per pod showed significant and negative correlation with - seed weight.

Singh et al. (1976) reporded that seed yield was positively correlated with the number of branches and pods per plant. Whereeas 100-seed weight was negatively correlated with the number of seeds per pod.

Oraon et al. (1977) reported that henolypic correlations were slightly higher than their correlations esponding phenotypic correlations. Grain yield per plant was positively correlated with number of pods per plant and number of seeds per pod.

Tyagi et al. (1982) coneladed that grain yield was found to be positively associated with pods per plant, seeds per pod and secondary branches.

Islam et al. (1984) reported taht yield per plant was significantly and positively correlated with pods per plant and number of secondary branches per plant.

Khorgade et al. (1985) observed that partical correlation and regression studies showed that 100-seed weight and

branches per plant were the most important yield components of 18 selection indices compared. The only single character index was more effective than yield was 100-seed weight.

Singh et al. (1986) observed that seed size. Pods per plant and primary branches per plant were the main yield component traits.

Paliwal et al. (1987) noted that seed yield per plant was positively correlated (at phenolypic level) with plant height days to 50 percent maturity and days to 50 percent flowering.

Sharma et al. (1988) found that seed yield was positicely assoeiated with plant spead of primary branches, secondary branches per plant, pod bearing length, number of pods per plant, biological yield and harvest index.

Jivani and Yadvendra (1998) reported that yield is positively and significantly correlated with branches per plant, pods 100-seed weight and it was suggested that number of branches and pods per plant, 100-seed weight and harvest index could be used to make indirect selection for seed yield.

Malik (1988) reported that pods plant, seeds per pod

and 100-seed weight were positively vorrelated wisth yield.

Sindhu and Mandal (1989) reported that seed yield was positively correlated with primary and secondary branches, pod number & seed number and seed per pod.

Chaudhary et al. (1991) Concluded through their study that biologival yield was main deter minant of seed yield.

Lal et al. (1993) obrerved that seed yield was significantly and positively correlated with pod number and plant beight and significantly but negatively correlated with 100-seed weight.

Arora and Kumar (1994) concluded that seed yield per plant ws positively associated with biological yield per plant, pods per plant, plant height and 100-seed wieght.

Rao et al. (1994) reported that seed yield per plant had significant and positive asso eiatio n with pods per plants, harvest index, secondary branches, primary branches, primary branches and 100-seed weight.

Bham bolta et al. (1994) revealed positive asso eiation of pod bearing branches per plant, pods per plant and plant height with seed yield.

Sarvila and Hoyal (1995) revealed significcant assoeiation between yield and 100-seed weight, plant height, number of primary branches, secondry branches, number of pods per plant, daysto

maturity and days to 50 percent flowering at both henotypic and phenotypic level.

Chand and Singh (1997) studied on eight yield compohents in 49 henotype grown during 1983-84 and concluded that number of pods and seeds per plant were the most important yield contributing characters.

Altinbase et al. (1998) reported significant differences among the genotypic performances for seed yield and 100-seed weight. All simple and rank correlation between the two trails were estimated to be non-significant. Some genotypes with hegher yields and bolder seeds than control cultivars were suitable for branches per plant. 1000-seed weight and seed yield was recommended based on the results.

Yadav and Sharma (1998) reported the yield to be positivelty correlated with days to maturity and seeds per pod and megalively correlated with days to 50 percent

flowering number of branches per plant and 100-seed weight.

Wahid and Ahmed (1999) reported that plant height and pods per plants had a strong and positive asso eiation with seed yield.

Kumar and Sharma (1999) reported that number of pods per plant, 100-seed weight and harvest index showed highly significant and possitive correlations with seed yield per plant.

5. PATH COEFFICIENT ANALYSIS :

Path coefficient analysis was origimally proposed by Wright in (1921) and later on described by Dewasy and Lu in (1959) in a more lucied manner, Path coefficient is simply standardized partial regression coefficient and as such meas ures the direct imfluence of on variable upon another which permits the separation of "r" (Correlation coefficient) in two component of direct and imdirect effect. The use of path coefficient analysis requires an eause and effect situtiaon among variables.

The literature available for the path coefficient anlysis in chickpea (Cicer arietinum L.) are discussed below:

grain yield per plant was found to be high but negative.

Singh et al. (1978) reported that a selection index based on more number of pods and primary branches and lese secondary branches should improve the yield.

Tomar et al. (1982) observed that pods per plant and secondary branches were the most stable and important yield contributing traits. The another characters. Which would be kept im mind for selection of plants were 100-grains weitght, seeds per pod and pod bearing length coupled with longer duration of seed development would provide a better plant type.

Tyai et al. (1982) reported that primary branches per plant, seeds per pods and 100-seeds weight had higher positive direct effects on grain yield.

Singh et al. (1985) indecated that seeds per pod had the highest direct effect on yield while most of the other characters affected the yield indirectly via pods per plant.

Singh (1986) noted that pods per plant, seed per plant and secondary branches per plant had the gretest effects on yield, seed weight was on pods per plant, seeds per pod and branches per plant.

Paliwal et al. (1987) reported that 100-seed weight had the highest positive direct effect on yield followed by pods per plant, seeds per pod and days to 95 perent at malurety.

Sharma and Maloo (1988) examined that number of pods per plant had the maximum direct effect in both the plantigs followed by number of primary branches per plant and days to flowering.

Sharma (1989) concluded that the number of pods per plant exhibited the highest derect positve contribution to wards the seed yield.

Sindhu et al. (1991) reported that opds per plant had the highest direct genotypic and phenotypic effects on seed yield. They again resolve that seed yeild was positively associated with seeds per pod, primary and secondary branches and ponds per plant and the letter three traits had good asso-ciation among themselves.

Lal et al. (1993) Reported the number of pods per plant had direct effect on sead yield followed by plant height.

Arun (1994) Suggested that while making selection the maximum emphasis should be given on blologieal yield.

Sarvalia and Goyal (1994) Reported that number of pods per plant and 100-seed weight had high direct effect on seed yield.

Arora et al. (1995) Observed that biological yield per plant, harvest index, pods per plant and 100-seed weight had the highest positive direct effect on seed yield per plant.

Das Gupta et al. (1995) Determined that the pods per plant, 100-seed weight per plant, seeds per plant and seeds per pod registered highly positive direct effects on yield.

Singh et al. (1996) Concluded that bio-mass per cent had the greatest dirst effect on seed yield followed by 100-seed weight and seed per pod.

Yousefi et al. (1997) Observed the path coefficients and showed that 100-seed weight, number of pods per plant and number of seeds per pod had high direct effects on yield.

Cinosy and yaman (1998) Reported that nearly about 125 Populations were examined for 17 yield components at several places in Turkey in 1993. They got Significent correlations between pods per plant and seed weight per plant. and seed weight per plant. Direct effect on leoflet

length, length of pods and seeds per pod on seed weight were Significant. They also revealed that negative correlation between seed weight, period of flowering and canopy height.

Kumar and Kuamr (1999) Reported that path coe fficient nalysis indicated that harvest index and biomass yield per plant registered highly positive direct effects on seed yield.

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CHAPTER - III

MATERIALS AND METHODS

CHAPTER - III

MATERIAL AND METHODS

MATERIAL :

The materials for the present investigation comprising of 10 Varieties of chickpea. (Cicer arietinum (L)) were selectid.

The had been obtain from chandrashekhar Azad University of Agriculture & Technology Kanpur (U.P.) All the varieties have been listed in the following table. 1

Table-1

S.No.	Varieties
1	ICC-11441
2	ICC-12048
3	ICC-10039
4	ICC-11254
5	ICC-12288
6	ICC-10587
7	ICC-2296
8	NEC-109/4829
9	Radhe
10.	ICC-10036.

METHOD :

(a) Field Layout :

The materials was Sown in a vandomized block with 3 replication on October 20,2000. Each treatment sown in a plot of to rows, each 16 m × 12 m. The distance between 2 rows 50 cm. An approrimate space or for 5 cm. between plant to plant was maintaned by thining. The experiment was condicted at the research from of Brahmanand Post Graduate college Rath (Hamirpur) U.P.

(b) Characters Studies :

The data on the following characters were recorded on 5 rendomly chosen plants in all 150 plants were studied. The selected plant were tegged with proper in formation for identification. Border rows were in cluded from the experiment during selection new ever disease abnormal plants were avaided.

(c) Recording of observation :

The observation of the following eight important characters were recorded on 5 rendomly selection plant from each plots as given .

Table No. 2

S. No.	Name of the Trait	Symbol
1	Days to flower	X_1
2	Plant neight	X_2
3	No. of Branches per plant	X_3
4	No. of pod per plants	X_4
5	No. of seed per plants	X_5
6	Days to Maturity	X_6
7	Test weight	X_7
8	Yield per plant	X_8

1. Days to flower (X_1)

Days to flowering were calculated from data of sowing to frist flowering.

2. Plant height (X_2)

The plant height was measured from bottom to top in em.

3. No. of Branch per Plants (X_3)

All the Brance per plant arising from the note were counted.

4. No. of pod per plant (X_4)

Total pod of per plant were counted and werer divisded by five the average.

5. ***No. of seed per plant (X_5)***

The seed of five plant pod were counted and they had beed devided.

6. ***Days to Maturity (X_6)***

Days to maturity were counted the data of sowing and data of harvesting.

7. ***Test weight (X_7)***

100 seed from each plant were counted and weighted in grams for the Gm.S.

8. ***Yield per plant (X_8)***

The yield of grain per plant was weighted in grams.

D. STATISTICAL METHOD

1. MEAN :

It is the sum of measurement or observation of divided by their number. Thus for each character the observation of 10 plant was averaged in accordence with the following formula-

$$\text{Mean} = \frac{Sx}{N}$$

Where :

SX = Sum of all the observation.

N = Number of observation.

2. ANALYSIS OF VARIANCE :-

The procedure for the analysis of variance of each character for randomized block disign is a given below.

STEP - I

First the variety total (T) the replication total (R) and Grand total (G.T.) were obtained in accordance with following table.

Table - 3

S.No.	Treatment	Replication		Total
	R-I	R-II	R-III	
1	X_{11}	X_{12}	Xin	T_1
2	X_{21}	X_{22}	X2n	T_2
3	Xm_1	Xm_2	Xmn	Tm
	Total	R_1	R_2 R_n	G.T.

Step- II

Calculation of sm of squares :-

The sum of Squares were obtained as following :-

1. Correlation factor (c.f.) = $\frac{(G.T.)^2}{N}$

2. Total sum of squares (T.S.S.) =

$$(X^2_{11}+X^2_{12}\ldots\ldots+X^2m2+X^2mn)\text{- c.f.}$$

3. Replication sum of squares.

$$\text{(R.S.S.)} = \frac{R_1^2 + R_2^2 \text{ --------- } + (Rn^2)}{\text{Number of treatment}} \ldots\ldots \text{c.f.}$$

4. Treatment sum of Squares. =

$$= \frac{T12+T22+\ldots\ldots\ldots\ldots Tn2).}{\text{Number of replication}}$$

5. Error sum of squares (E.S.S.) = T.S.S.- (R.S.S. - Tr.S.S.)

STEP-III

The sum of squares were arranged in the following table to test the significance of difference between treatment.

Table-4:

S.No.	Sources	D.F.	S.S.	M.S.	V.R.	Value
1	Replication	(R-1)	r	vr	vt/ve	
2	Treanment	(T-1)	t	vt	vr/vc	5%
3	Error	(R-1)(T-1)	ve			
	Total	(TR-1)				

In the variance ratio Vt/ve for treatment lesser of percent level of significant of the differenees between treatments are considered to do not significant and Vice-versa.

COMPONENT OF VARIANCE

Consedering that all the variance tested her were genetically uniform the except mean sum of squares for error (M.Sc.) i.e. 6 2g will be purely random environment al variace. The mean sum of squares between variance will consist of the variance.

1. Attributes to varietal differences (Genotypic differencs)
2. Due to invironmental

Variation among individual of genotypic this the expected mean sum of squares would be follows.

E (M.Sr) = Variance e+r variance g

E. (M.Se) = Variance

$$\text{Variance } g = \frac{\text{M.Sv-Mse}}{r}$$

Phenotypic variance = variance P = variance g + variance e

All the three components of each character

were arranged in the following table.

Coefficient of variation were calculated as following.

(a)Phenotypic coefficient of variation :-

$$= \frac{\sqrt{\text{Variance p}}}{\bar{X}} \times 100$$

(b) Genotypic coefficient of variation (G.C.V.)

$$= \frac{\sqrt{\text{Variance g}}}{\bar{X}} \times 100$$

(c) Heritability (Broad sence)

It is the ratio opf genotypic variance to phenotypic variance.

$$\text{Heritability } (h^2) \text{ (Broad sense)} = \frac{\text{Variance g}}{\text{Variance P}}$$

(d) Genotice Advance

It is calculated through following formula.

$$\text{G.A.} \frac{\text{Variance g}}{\sqrt{\text{Variance P}}} \times \text{K}$$

Where. K= selection intensity at 5% (2.06)

Variance ^{2} = Phenotypic variance

h^2 (b) = Heritability in broad sense

ANALYSIS OF CO-VARIANCE :

The analysis of corariance was carried out as illustrated below :-

Note - R_1, R_2, R_3 represent replications.

Where as × and Y represent the characters under study.

Table-6 For working out the analysis of Co-variance

Treat ment	R1		R2		R3		Total	
	X	Y	X	Y	X	Y	X	Y
1.	X_{11}	Y_{11}	X_{21}	Y_{21}	X_{31}	Y_{31}	T_1	T_1
2.	X_{12}	Y_{12}	X_{22}	Y_{22}	X_{32}	Y_{32}	T_2	T_2
....	....	....	....	....	....	....	....	.....
8..	X_{18}	Y_{18}	X_{28}	Y_{28}	X_{38}	Y_{38}	T_8	T_8
Total	R_1	r_1	R_2	r_2	R_3	r_3	G.T. (x) G/T	

(1) Correction factor (C.F.) $= \dfrac{\text{G.T. }(\times) \times \text{G.T. }(Y)}{N}$

(2) T.S.P. = (XY.XY, Y) + ...+ (XmnX:Xmny)-C.F.

(3) Relication s.p.

$$= \left[\frac{(R_1 X.\ R_1\ Y) + (R_2X.\ R_2Y) + \ldots (RnX.\ RnY)}{\text{Number of Treatments}} \right] - \text{C.F.}$$

(4) Treatment sum of products (Tr. S.P)

$$= \left[\frac{(T_1X\ .\ T_1Y) + (T_2X\ .\ T_2Y) + \ldots + (TnX\ .\ TnY)}{\text{Number of replications}} \right] - \text{C.F.}$$

(5) Error S.P. = T.S.P. - (Replication S.P. + Treat. S.P.)

COMOPONENT OF Co. VARIANCE :-

Expectation of mean sum of product follow the same principles as there mean sum squares.

Thus,

$$E\ (M.S.Pv) = e1\ e2 = r\ g1\ g2$$

$$E\ (M.S.Pe) = e1\ e2$$

$$g1\ g2 = \frac{M.S.Pr - M.S.Pe}{\mathbf{r}}$$

$$P1\ P2 = g1\ g2 + e1\ e2$$

There components were calculated and were summarized in the following table.

Table - 7 :- Component of Co-variance.

S.No.	Character	Components		
		g_1g_2	e_1 e_2	p_1p_2
1.	Days to flowers Vs. Plant Height			
2.	-do-Vs. of branches per plants			
3.	-do-Vs. no pod per plant			
4.	-do-Vs. no of seed per pod.			
5.	-do-Vs. days to maturity			
6.	-do-Vs. 100 seed testweight.			
7.	-do-Vs. yield per plant			
8.	Plant height Vs. no of Branches per plant			
9.	Plant height Vs. of pod per plants.			
10.	Plant height Vs. of seed per plant			
11.	Plant height Vs. Days to Maturity			
12.	Plant height Vs. Test weight.			

13.	Plant height Vs. yeild per plant.			
14.	No. of branches per plant Vs. No. of pod per plant			
15.	No. of Branches per plant Vs. No. of seed per plant			
16.	No. of Branches per plant Vs. days to maturity			
17.	No. of branches per plant Vs. test weight			
18.	No. of Branches per plant Vs Yeild per plant.			
19.	No. of pod per plant Vs. No. of seed per plant			
20.	No. of pod per plant Vs. Days to Maturity			
21.	No. of pod per plant Vs. test Weight			
22.	No. of pod per plant Vs. Yield per plant			
23.	No. Seed per plant Vs. Days to maturity			

24.	No. of seed per plant Vs. Test weight.			
25.	No. of seed per plant Vs. yield per plant			
26.	Days to maturity Vs. Test weight.			

SIMPLE CORRELATION :

Correlation were calculated using the fallowing formula :-

$$r\,(XX) = \frac{\sqrt{COV.\ X_1X_2}}{V(X_1V(X_2)}$$

Where,

r (X1X2) is the correlation between X_1 & X_2

COV. X1X2 is the covariance between X_1 & X_2

V (X1) is the Variance of X_1

V (X2) is the Variance of X_2

CORRELATION COEFFICIENT :-

The correlation coefficient between the variable were computed with the help of following formula.

1. GENOTYPIC CORRELATION COEFFICIENT :-

Genotypic correlation coefficient was calculated by the

following formula as suggested by rabinson et al. (1951).

$$\text{Genolypic Correlation} = \frac{\text{Genotypic Correlation}}{\sqrt{\text{G.V. For (X). G.V. for (Y)}}}$$

Where :-

G.V. for X = Genotypic Variance for X

G.V. for Y = Genotypic Variance for Y

X & Y are two variables.

(a) $$\text{Genotypic Covariance} = \frac{\text{M.S.P. Treat. (XY)-M.S.P. error.(X)}}{r}$$

(b) $$\text{Genotypic Variance of X} = \frac{\text{M.S.S. Treat. (X)-M.S.S.error (X)}}{r}$$

(c) $$\text{Genotypic variance of Y} = \frac{\text{M.S.S Treat (X)- M.S.S. error (X)}}{r}$$

2. **phenotypic correlation coefficient :-**

It was calculated by the folowing formula suggesed by robinson et al. (1951)

$$\text{Phenotypic Correlation} = \frac{\text{Phenotypic Variance}}{\text{Ph.V. for (X.) Ph.v. for (Y)}}$$

Where :-

Ph.V. for X = Phenotypic Variance for X

Ph. V. for Y = Phenotypic Variance for Y

X & Y are two variables.

(a) $$\text{Phenotypic Covariance} = \frac{\text{M.S.P. Treat. (XY) - M.S.P. error (X)}}{r}$$

(b) $$\text{Phenotypic variance of X} = \frac{\text{M.S.P. Treat (X) - M.S.S. error (X)}}{r}$$

(c) $$\text{Phenotypic variance for Y} = \frac{\text{M.S.P. Treat (Y) - M.S.S error (Y)}}{r}$$

3. ENVIRONMENTAL CORRELATION COEFFICIENT :-

Environmental correlation coefficient (re) was determined by the following formula.

$$re = \frac{\text{S.P. XY}}{\sqrt{\text{S.S (X)} \times \text{S.S. (y)}}}$$

where :-

re = Environmental correlation coefficient

S.P. (XY) = Sum of products of XY

S.S. (X) = Sum of Square of X

S.S. (Y) = Sum of Square of Y

X & Y are two variables.

TEST OF SIGNIFICANCE :-

The significance of correlation coefficient was tested by the t' test by using by fallowing formula.

$$t = \frac{r}{\sqrt{1-r2}} \times \sqrt{n-2}$$

Where :

r = Correlation coefficient

n = Number of observation

The calculated t' was compared with the table value of t' at 5 % levels of significant for (n-2) degree of freedom. It the calculated value of t' was higher than

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table the correlation coefficient was termed as significant one.

PATH COEFFICIENT ANALYSIS :-

Path coefficient is standard partial regression coefficient and as such it measurement the direct influence of one variable upon another and indirect effect the we of this technique requires a cause and effect situation among the variable.

CASUAL SYSTEM :-

It the casual system, as given in figures. The direct influence as measured by Path coefficient and asscociation as measured by the genotypic correlation coefficient are given.

The Path coeffecient in this intoance were obtained by the simultansous solution of the following equation which express the basic rilationship between correlation and path coefficients.

1. r110 = P110 + r12 p210 + r13 p 310 +r14 p410 + r15 p510 + r16 p610 + r17 p710 + r18 p810 + r19 p910.

2. r210 = r21 p110 + p210 + r23 p310 + r24 p410 + r25 p510 + r26 p610 + r27 p710 + r28 p 810 + r29 p910.

3. r310 = r31 p110 + r32 p210 p310 + r34 p410 + r35 p510 + r36 p610 + r37 p 710 + r38 p810 + r39 p910.

4. r410 = r21 p110 + r42 p210 r23 p310 + p410 + r45 p510 + r46 p610 + r47 p710 + r47 p710 + r48 p810 + r49 p910.

5. r510 = r51 p110 + r52 p210 + r53 p310 + r54 p410 + p410 + r56 p610 + r57 p 710 + r68 p810 + r69 p910.

6. r610 = r61 p110 + r62 p210 + r63 p310 + r64 p410 + r65 p510 + p610 + r67 p 710 + r68 p810 + r69 p910.

7. r710 = r71 p110 + r72 p210 + r73 p310 + r64 p410 + r65 p510 + p610 + p 610 p710+ r78 p810 + r79 p910.

Where :-

P = Path Coefficient.

r = Coeffecient of correlation.

the residual iffects was calculated by the following formuta :-

R = 1- (Piy. riy)

$$PR_4 = \frac{\qquad}{\sqrt{1-(P_{18}\,r_{18})-(P_{28}\,r_{28})-(P_{38}\,r_{38})-(P_{48}\,r_{48})-(P_{58}\,r_{58})-(P_{68}\,r_{68})-(P_{78}\,r_{78})-(P_{88}\,r_{88})-(P_{98}\,r_{98})}}$$

Where :-

R = Residual effect

Piy = Path coefficient of 9th characuers with yield

rix = Genotypic Correlation coefficient of 9th characters with yield.

It is evident that correlation between yield on one hand and the various characters on the other, have been partitioned in the direct and indirect effects. As a guideline for interpretation of pathe analysis results, the following broad points may be xept in view.

1. In the correlation coefficient between a causal factor and the effect is almost equal to its directs effects, then correlation explain the true relationship and the direct selection through this trait will be effective.

2. If the correlation coefficient is pisitive but the direct effect is negative or negligible, the indirect effects seem to be cause of correlation. In such situations, the indirects causal factors are to be considered simultaneously for selection.

3. Correlation coeffecient may be negative but the direct effect is positive and high under these circumstance, a restricted simultaneous selectionmodel is to be followed e, e, restrictions are to be imposed tonullify the undesirabel indirect in order make use of the directs effects.

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CHAPTER - IV

EXPERIMENTAL FINDINGS

CHAPTER -IV

EXPERIMENTAL FINDINGS

The present investigation aimed to detiermine the following analysis and the results obtained on their account are present here.

1.Analysis of Variance

2.To estimate the genotypic and phenotypic coefficient of variabilityes

3.Correlation coefficient 9Genotypic and phenotypic)

4. Path coefficient analysis

5.Heritability and genetic advance.

The result obtained from the studies are presented below.

1.Analysis of Variance:-

All the Eight character in the present investigation were significant except plant height it is clear the variance ratio in the present matirial that the choice of lines was appropriate for the estimation for selection parameters. Mean some of sqrares and variance ratio for all the eight characters namely days to flowering. Plant height, no. of branches per plant, no. of pod per plant, no. of seed per plant, days to maturity, test weight, yield per plant have been giren in table no. 1.

2.To estimate the genotypic and phenotypic coefficient of variabilityes:-

The genetic and phenotypic variabilityes of different characters wee

Table.1. Anova. for different characters in the present investivgation.

S. No.	Characters.	Replication	Treatment	F. Value
1.	Days to Flower.	6.226	103.884	26.117 *
2.	Plant height (c.m.)	40.414	325.772	62.643 *
3.	No. of Branches per Plant	.471,67	159.731	31.713 *
4.	No. of Pod per plant.	1415.375	44348.056	45.148 *
5.	No. of Seed per pod.	0.010	0.209	2.684 *
6.	Days to maturity.	6.156	32.8006	45.991 *
7.	100 Seed. Test Weight (G.M.)	2.321	82.527	60.576 *
8.	Yield per plant (G.M.)	1.109	1591.878	176.972 *

*** Significant at 5% level.**

coneluded and they have been shown in table no. 2.

The genotypic variabilities of no. of branch per plant (29.36), no. of pod per plant (41.59), test weight (36.10), yield per plant (52.67), were found height.

The phenotypic variabiliters on no. of branch per plant (30.76), no. of pod per plant (42.98), no. of seed per pod (8.65), days to maturity (7.47), yield per plant (53.11), were found height where as other characters considerable low variabilities.

The variabilities percentge indicate that the selection con be made easily through these characters.

3.To estiamate the correlation coefficients genotypic and phenotypic:-

Simple correlation among different characters had been calculated and they have been presented in table no. 3 following characters were found with positive and significant genotypic and phenotypic correlation with yield plant height (0.574), no. of pod per plant (0.863), no. of seed per pod. (0.437), No. of branches per plant (0.644), test weight (0.081). Following characters were found with positive and significant phenotypic correlation with yield no. of pod per plant (0.425), no. of seed per pod (0.246).

No. of pod per plant vs test weight (-0.200), no. of seed per pod vs days to matureity (0.284). no. of seed per vs test weight (0.000), days to maturity vs. yield per plant (-0.79), test weight vs yield per plant (0.081). following characters were found with negative and significant phenotypic correlation.

Plant height vs days to maturity (-0.133), no. of pod per plant vs test

Table.2. Coefficient of variance for 8 characers of chick pea.

S.N.	Characters.	Coefficient of variance.	
		Phenotypic	Genotypic
1.	Days to Flower.	7.77	7.35
2.	Plant height (c.m.)	14.83	14.48
3.	No. of Branches per Plant	30.76	29.36
4.	No. of Pod per plant.	42.98	41.59
5.	No. of Seed per pod.	8.65	5.19
6.	Days to maturity.	7.47	7.23
7.	100 Seed.	37.00	36.10
	Test Weight (G.M.)		
8.	Yield per plant (G.M.)	53.11	52.67

Table-3 Genotypic $ phenotypic correlation Coefficients among characters.

Characters		Daya to flower	Plant height (c.m.)	No. of branches per plant	No. of pod per plant	No. of seed per pod.	Days to. maturity	100 seed test weight (G.m.)	yield per plant (G.m.)
Days to Flower	G.	1.000	-0.310	0.077	0.180	0.490*	0.627*	-0.546*	0.204
	P.		-0.328	0.035	0.167	0.330	0.553*	-0.509*	0.200
Plant height	G.		1.000	0.623*	0.567*	-0.123	-0.147	0.539*	0.574*
	P.			0.593*	0.543*	-0.126	-0.133	0.528*	0.522*
No. of branches per	G.			1.000	0.843*	-0.350	-0.154	-0.142	0.644*
plant	P.				0.765*	-0.166	-0.105	-0.177	0.595*
No. of pod per plant	G.				1.000	0.121	-0.315	-0.200	0.863*
	P.					0.128	-0.299	-0.177	0.835*
No. of seed per pod	G.					1.000	0.284	0.000	0.437*
	P.						0.154	-0.007	0.246
Days to maturity	G.						1.000	0.174	-0.079
	P.							0.181	-0.075
100 seed test weitht	G.							1.000	0.081
(G.m)	p.								0.074

Significatnt at 5% level

weight (-0.177), no. of seed per vs days to maturity (0.154), no. of seed per pod vs test weight (-0.007), days to maturity vs yield per plant (-0.075), test weight vs yield per plant (0.074).

4.Path coefficient analysis:-

We calculated path analysis to detect the direct and indirect effect of each characters on yield and they have been presented in table no. 4.

The direct effect of dyas to flower (-1.286), was found positive which ws relevant to the positive correlation (0.204) of this trait on yield.

The direct effect of plant height (0.064) was found positive it is irrelevant to positive correlation with yield of this trait. The indirect effect of plant height via days maturity was found positive.

The magnitude of direct effect of no. of Branch plant (-0.393) was found positive with yield positive.

Following characters were found with positive and significant genotypic correlation.

Days to flower vs. no. of branch per plant (0.077), days to flower Vs. days to maturity 90.727), days to flowers Vs. test weight (-0.546).

Following characters were found with positive and significant phenotypic correlation.

Days to flower Vs no. of branch per plant (0.035), days to flower Vs. test weight (-0.509).

Following charactor were found with positive and significant phenotypic correlation with yield.

No. of pod per plant vs yield per plant (0.835), no. of seed per pod vs yield per plant (0.246), days to maturity vs yield per plant (-0.075), yield per plant vs yield per plant (0.074).

Following character were found with negative and significant genotypic correlation with yield.

Days to maturity (-0.079)

Following characters wee found with negative and significant phenotypic correlation with yield.

Days to maturity (-0.075)

The positive direct effect of no. of pod per plant (1.584) was found positive and it is higher than any direct effect all of the another traits and it is higher them any indirect effects.

The direct effect of no. of seed per (0.416) was found positive which was relevant to the positive correlation (0.437) of this trait on yield. the height indirect no. of branches per plant vs. no. of pod per palnt (1.335) was found positive.

The negative direct effect of Test weight (-0.596) it is relevant to negative. Correlation with yield. It is lesser than indirect effect through days to maturity via of pod per plant was found negative. The test weight (-0596) was found positive but irrelevant to negative correlation with yield.

Table-4 Direct and indirect effects (Path coefficient) of Yield Components on yield.

Characters		Daya to flower	Plant height (c.m.)	No. of branches per plant	No. of pod per plant	No. of seed per pod.	Days to. maturity	100 seed test weight (G.m.)	yield per plant (G.m.)
Days to Flower	G.	-1.286	-0.020	-0.030	0.284	0.204	0.727	0.325	0.204
	P.	0.178	0.004	-0.001	0.150	0.021	0.012	-0.164	0.200
Plant height cm.	G.	0.398	0.064	-0.245	0.899	-0.051	-0.170	-0.321	0.574*
	P.	-0.058	-0.013	-0.024	0.488	-0.008	-0.003	0.170	0.522*
No. of branches per plant	G.	-0.099	0.040	-0.393	1.335	-0.146	-0.178	0.085	0.644*
	P.	0.006	-0.008	-0.041	0.688	-0.810	-0.002	-0.038	0.595*
No. of pod per plant	G.	-0.231	0.036	-0.331	1.584	0.050	-0.365	0.119	0.863*
	P.	0.030	-0.007	-0.031	0.899	0.008	-0.006	-0.057	0.835*
No. of seed per pod	G.	-0.630	-0.008	0.138	0.192	0.416	0.329	0.000	0.437*
	P.	0.059	0.002	0.007	0.115	0.062	0.003	-0.002	0.246
Days to maturity	G.	-0.807	-0.009	0.060	-0.498	0.118	1.160	-0.183	-0.079
	P.	0.099	0.002	0.004	-0.269	0.010	0.022	0.058	-0.075
100 seed test weitht	G.	0.703	0.034	0.056	-0.317	0.000	0.201	-0.596	0.081
	p.	-0.091	-0.007	0.005	-0.159	0.000	0.004	0.322	0.074

Significatnt at 5% level

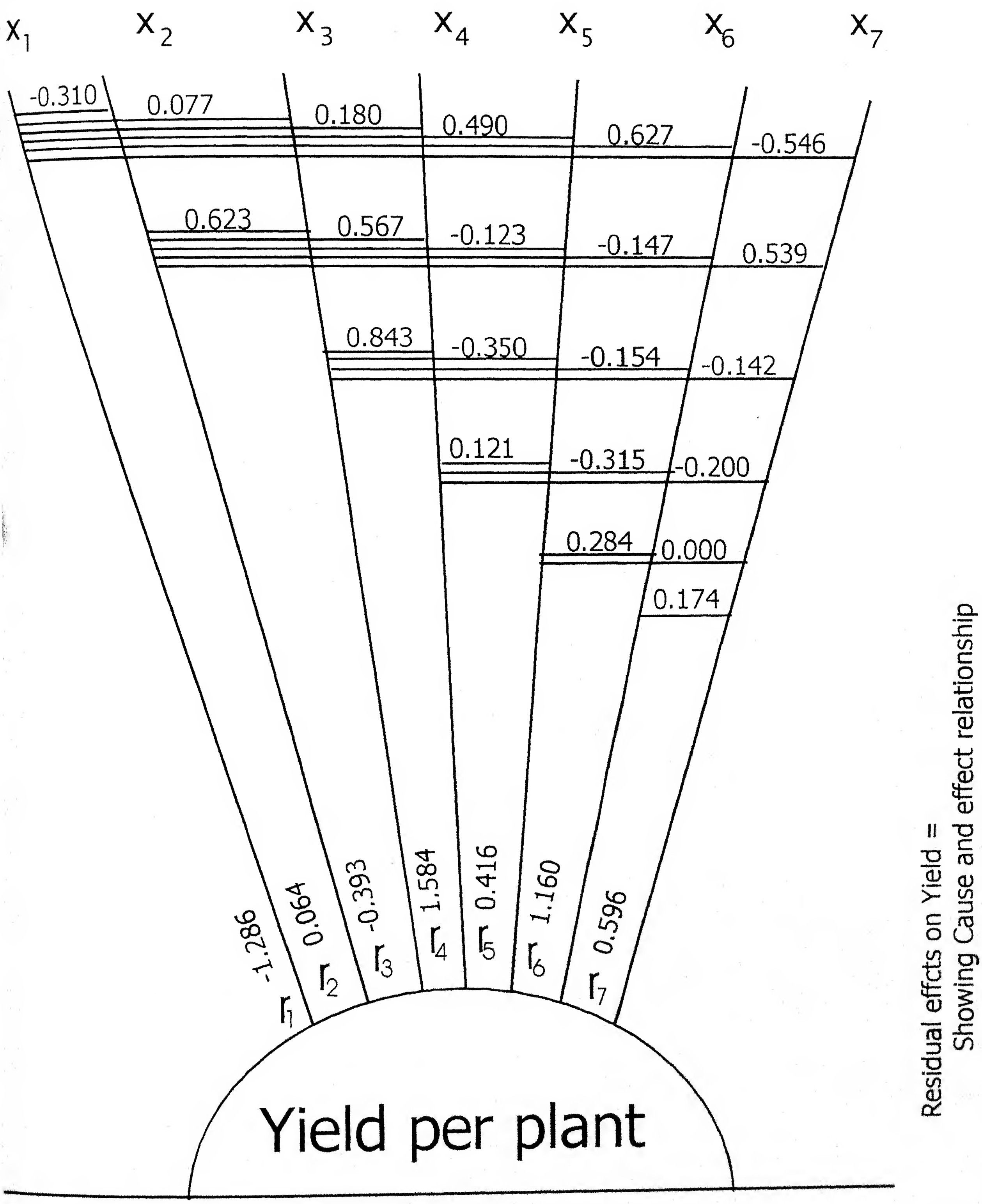

Fig No. 2 Path Diagram

5.Heritability and Genetic Advance:-

Heritability in broad sinse and expected genetic advance had been calculated and they have been shwn in table no. 5

High heritability estimate being more than 90% were shown by character viz.

Days to floweing, plant height, no. of branch per plant, no. of pod per plant. no. of seed of per plant, test weight yield per plant. Medium heritanbility being that is between 30% to 50% were showed one charcter s viz days to maturity (93.7) showed low heritability that is less than 30% . The genetic advance of each characters were found low.

High haritability and low genetic advance indicate these varieties can be used in the further hybridization programme.

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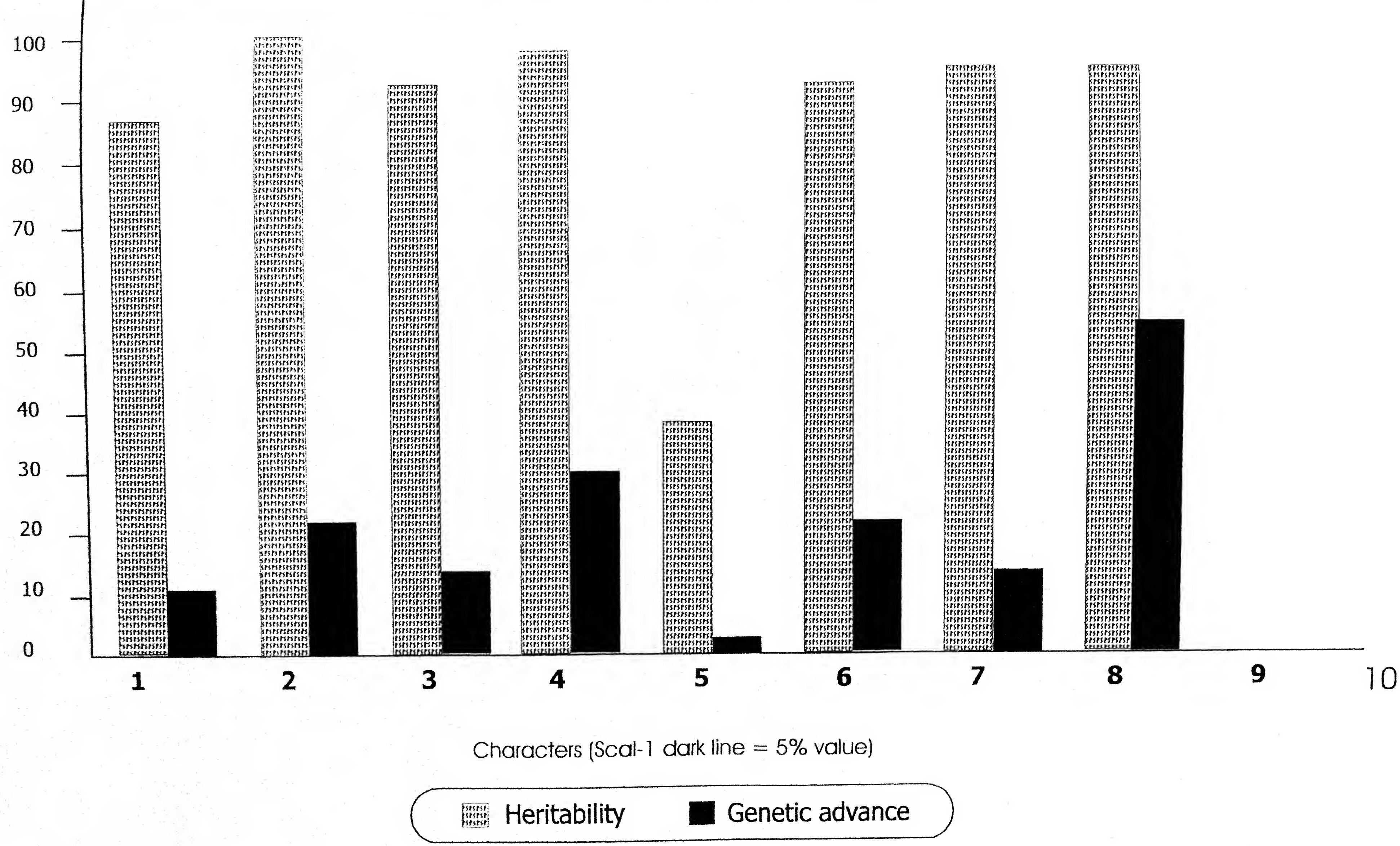
Table.5. Heritability and Genetic advance for 8 characers in chick pea.

S.N.	Characters.	Heritability (%)	Genetic advance (%)
1.	Days to Flower.	89.3	11.24
2.	Plant height (c.m.)	95.4	20.79
3.	No. of Branches per Plant	91.1	14.12
4.	No. of Pod per plant.	93.6	239.66
5.	No. of Seed per pod.	36.0	0.08
6.	Days to maturity.	93.7	20.63
7.	Test Weight	95.2	10.45
8.	Yield per plant	98.3	46.92

Fig. Heritability and Genetic advance (in %)



PHOTOGRAPHY

CHAPTER - V

DISCUSSION

CHAPTER - V

DISCUSSION

The main objective of plant breeding is to develop the vareties superior in all most all the characters in cluding yield in comparison to the existing types with the help of associated characters of breeding value which result in maximization of production of crops plants.

The importance in quantitatively in herited attributes is based on the exploitation of genetic variability in the material for study. Variability being parameter measured the wide range of variation of a specific character and provides.

The chance to breeders for formulation of the breeding programme for improvement of self fertilized crop like chick pea.

The variance ratios of all the eight characters were found significant which indicated that the choice of variety was appropriate for the present investigation.

The genotypic as well as phenotypic variation of most of the characters were found high which were in agrement taht the selection throuch these characters can be made easity correlation study.

Only four characters viz. palnt height, no. of branches per plant no. of pod per plant and no. of seed per pod were found with positive and significant correlation with yield which indicated that these four characters had their true relationship with yield.

Following authors with also reported the same finisings the names of author have been given under that character which was found positively and significantly correlated with yield by them.

Plant Heght:

Lal et al. (1993) and Arora (1991), Arora and Kumar (1994), Bhambolta et al. (1994), Sarvela and Goyal (1995).

No. of Branches per plant:

Gupta et al. (1972), Bahl et al. (1976), Singh wt al. (1976), Tyagi et al. (1982), Tomar et al. (1982), Islam et al. (1984), Sharma et al. (1988), Jivani and Yadvendra (1988), Sindhu and Mandal (1989) and Rao et al. (1994)

No. of pod per plant:

Bhatia et al. (1993), Jahagirdar et al. (1995). Jivani and Yadvendra (1988), Gupta et al. (1972), Singh et al. (1973), Bahe et al. (1976), Eslam et al. (1984), Lal et al. (1993), Rao et al. (1994) and Kumar and Sharma (1999).

No. of seed per pod:

Gupta et al. (1973), Sindhu and Mandal (1989), Das Gupta et al. (1995), Chavan V.W. (1994) and Ozdemir, S (1996).

Path analysis study:

To determine direct and indirect effects of different characters on yield we calculated path analysis. According to correlation analysis only four characters viz. plant height, no. of branches per plant, no. of pod per plant and no. of seed per pod

were found significantly correated with yield. So, we shall give analysis upon only these four characters.

The height direct effect (1.584) was shown by no. of pod per plant. The indirect effects of this trait were found lesser than the direct effect.

The second hight indirect effect was exhibited by no. of seed per pod (0.416) which indicated about its importance to contribute the yield.

The direct effect of plant height (0.064) was found lesser than the indirect effect via no. of pod per plant (0.899) which indirect that character was influnceing the yield indirectly through pod number.

The direct effect of no. of branches per plant (-0.393) was found negative which was irralevant to positive correlation of this trait with yield (0.644) which indirect that this characters was influencing the yield indirectly through other traits . The height and positive indirect effect (1.335) was found via no. of pod per plant. It means this trait too was influencing the yield through pod number.

On the basis of path analysis it was centerded that no of pod per plant was the most important yield influencing character.

Heritability and Genetic advance study:

All the characters expect no. of seed per pod were found with high heritability. No. of pod per pod showed medium heritability. High or medium heritability indicated that these characters can also be utilized in further breeding programme. The genetic advance of no. of pod per plant was found very high. High heritability and genetic advance indicated the superierity of no. of pod per plant and this trait

especially can be utilized in further breeding programme.

It is, therefore, suggested that the selection methodology can be adopted in chick pea to enhance the yielding ability. The plant with more no. of pod and more no. of seed per pod most be selected during selection programme.

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CHAPTER - VI

SUMMARY

CHAPTER VI

SUMMARY

The present study named as ***correlation and path analysis study in chick-pea [Cicer arietinum (L)]*** was conducted to worked the diverse genetic parameters by involving a group of in genotypics in respect of eight characters the experiments of 10 genotypic was laidout in Rabi season of 2001-2002 in a randomized block design with three reolication at the research farm of B.N.V. Rath in order to determine the various genetic parameters, viz. range of variation of the characters, genotypic and phenotypic coefficient of variability heritability and genetic advance for various attributes. Correlation coefficient analysis. Five plants were picked out randomly from each treatment replication wise to recorded data on eight characters, Results on the present study are attributed as under.

On 20-10-2000, 10 varieties of chickpea namely, 1cc-11441, icc-120 48, icc - 100 39, icc-100-11254, ICC-12288, ICC-10587,ICC-2296, NEC-109/4829, Radhe, ICC-100 36, were soun for the investigation the data viz. days to flower, plant height, No. of Branches per plant, No. of pod per plant, No. of seed per pod, Days to maturity, yield per plant, had been recorded further statistical and biometrical method had been adopted for the following calculations.

1. Analysis of variance (ANOVA)

2. To estimate the genotypic and phenotypic coefficient of variability.

3. Correlation coefficient (genotypic and phenotypic)

4. Path coefficient analysis.

5. Heritability and genetic advance.

The variance ratio of all the characters were found significant which indicated that these choice of varieties was appropriate for the present investigation.

The variabilities genotypic and phenotypic were found high except days to maturity. The high variabilities of all the characters were assuring that the selection can be made easily through there characters.

The genotypic and phenotypic components of variance of number of pod per plant, yield per plant days flower were high which indicated that inheritance of these characters were due to dominant genes where as the inheritance of other characters were due to recessive genes because, they wee showing low components of variance.

Only four characters viz. plant height, no. of branches per plant no of pod per plant and no of seed per pod were found with positive and significant correlation with yield which indicated that these four characters had their true relationship with yield.

The height direct effect (1.584) was shown by no. of pod per plant. The indirect effect of this trait were found lesser then the direct effect. This indicated superenacy of this trait on yield.

The second highest indirect effect was exhibited by no. of seed per pod (0.416) which indicated about its importance to contribute the yield.

The direct effect of plant height (0.064) was found lesser than the indirect effect via no. of pod per plant (0.899) which indirected that this characters was influencing the yield indirectly through pod number.

The direct effect of no. of branches per plant (-0.393) was found negative which was irrulevant to positive correlation of this trait with yield (0.044) which indicated that this character was influencing the yield indirectly through other traits.

The highest and positive indirect effect (1.335) was found via. no. of pod per plant. If means this trait too was influencing the yield through pod number.

On the dosis of the analysis it was uncluded that no of. pod per plant was the most important yield influencing character.

All the characters except no. of seed per pod were found with high heritability no. of seed per pod showed medium heritability. High or medium heritability indicated that these characters can also utilized in further breeding programme. The genetic advance of no. of pod per plant was found very high. High heritability and genetic advance indicated the superierily of no. of pod per plant and this trait esecially can be utilized as further breeding programme.

It is therefore, suggested that the selection methodology can be adopted in chickpea to enhance the yielding obility.

The plant with more no. of pod and more no. of seed per pod must be selected during selection programme.

CHAPTER - VII

BIBLIOGRAPHY

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CHAPTER - VIII

APPENDICES

APPENDICES

TABLE OF ANALYSIS OF VARIANCE.

Table-1. (Days to flower). X1

S.No.	Source	D.F.	M.S.S.	F. Value.
1.	Replication	2	6.226	1.565
2.	Treatment	9	103.884	26.116 *
3.	Error	18	3.977	
	Total	29		

Table-2. (Plant height). X2

S.No.	Source	D.F.	M.S.S.	F. Value.
1.	Replication	2	40.414	7.772
2.	Treatment	9	325.722	62.643 *
3.	Error	18	5.199	
	Total	29		

Table-3. (NO. of branches per plant). X3

S.No.	Source	D.F.	M.S.S.	F. Value.
1.	Replication	2	0.471	9.364
2.	Treatment	9	159.731	31.713 *
3.	Error	18	5.036	
	Total	29		

Table-4. (No. of pod per plant) X4

S.No.	Source	D.F.	M.S.S.	F. Value.
1.	Replication	2	1415.375	1.440
2.	Treatment	9	44348.056	45.148 *
3.	Error	18	982.227	
	Total	29		

Table-5. (No. of seed per pod) X5

S.No.	Source	D.F.	M.S.S.	F. Value.
1.	Replication	2	0.0100	1.284
2.	Treatment	9	0.0209	2.684 *
3.	Error	18	77.915	
	Total	29		

Table-6. (Days of maturity) X6

S.No.	Source	D.F.	M.S.S.	F. Value.
1.	Replication	2	6.156	0.863
2.	Treatment	9	328.006	45.991 *
3.	Error	18	7.31	
	Total	29		

Table-7. (Test Weight) X7

S.No.	Source	D.F.	M.S.S.	F. Value.
1.	Replication	2	2.321	1.704
2.	Treatment	9	82.527	60.576 *
3.	Error	18	1.362	
	Total	29		

Table-8. (Yield per plant) X8

S.No.	Source	D.F.	M.S.S.	F. Value.
1.	Replication	2	1.109	0.123
2.	Treatment	9	1591.878	176.972 *
3.	Error	18	8.995	
	Total	29		

TABLE OF ANALYSIS OF COVARIANCE

Table.9. Days to flower (x1) Vs. Plant hieght (cm.) x2

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	- 14.210	5.223
2.	Treatment	9	- 58.145	21.373 *
3.	Error	18	- 2.720	
	Total	29		

Table.10. Days to flower Vs. No. of Branches per plant.(x3)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	1.669	-1.058
2.	Treatment	9	7.986	-5.062 *
3.	Error	18	-1.577	
	Total	29		

Table.11. Days to flower Vs. No. of Pod per Plant. (x4)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-11.500	-6.167
2.	Treatment	9	375.583	201.430 *
3.	Error	18	-1.884	
	Total	29		

Table.12. Days to flower Vs. No. of Seed per Pod. (x5)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	0.179	5.095
2.	Treatment	9	0.596	16.951 *
3.	Error	18	0.0351	
	Total	29		

Table.13. Days to flower Vs. No. of Days to maturity. (x6)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-5.906	4.256
2.	Treatment	9	110.893	-79.909 *
3.	Error	18	-1.387	
	Total	29		

Table.14. Days to flower Vs. Test Weight.(in grams.) (x7)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-0.615	3.740
2.	Treatment	9	-0.0049	299.981 *
3.	Error	18	-0.164	
	Total	29		

Table.15. Days to flower Vs. Yeild per plant. (x8)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-0.617	-0.550
2.	Treatment	9	82.414	73.550
3.	Error	18	1.120	
	Total	29		

Table.16. Plant Height (x2) Vs. No. of Branches per Plant. (x3)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-3.375	-3.425
2.	Treatment	9	139.688	141.780
3.	Error	18	0.985	
	Total	29		

Table.17. Plant Height (x2) Vs. No. of Pod per Plant. (x4)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	131.500	14.077
2.	Treatment	9	2124.629	227.440
3.	Error	18	9.341	
	Total	29		

Table.18. Plant Height (x2) Vs. No. of Seed per Plant. (x5)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-0.213	3.366
2.	Treatment	9	-0.315	4.910
3.	Error	18	-6.334	
	Total	29		

Table.19. Plant Height (x2) Vs. Days tp Maturity. (x6)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	15.531	24.942
2.	Treatment	9	-46.373	-74.471
3.	Error	18	0.622	
	Total	29		

Table.20. Plant Height (x2) Vs. Test Weight. (x7)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	5.642	7.035
2.	Treatment	9	87.712	109.370
3.	Error	18	0.80	
	Total	29		

Table.21. Plant Height (x2) Vs. Yield per Plant. (x8)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	1.480	1.756
2.	Treatment	9	407.937	483.891
3.	Error	18	-0.843	
	Total	29		

Table.22. No. of Branches per plant (x3) Vs. No. of Pod per plants. (x4)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	2.750	-0.220
2.	Treatment	9	2170.361	-174.318
3.	Error	18	-12.450	
	Total	29		

Table.23. No. of Branches per plant (x3) Vs. No. of Seed per plants. (x5)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	0.0892	2.046
2.	Treatment	9	-0.470	-16.332
3.	Error	18	2.879	
	Total	29		

Table.24. No. of Branches per plant (x3) Vs. Days Maturity. (x6)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-1.472	-0.501
2.	Treatment	9	-31.264	-10.640
3.	Error	18	2.938	
	Total	29		

Table.25. No. of Branches per plant (x3) Vs. Test Weight. (x7)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	0.0698	0.112
2.	Treatment	9	-15.320	-24.650
3.	Error	18	-2.390	
	Total	29		

Table.26. No. of Branches per plant (x3) Vs. Yield per plant. (x8)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-0.326	0.136
2.	Treatment	9	316.103	-132.206
3.	Error	18		

Table.27. No. of Pod per plant (x4) Vs. No. of Seed per pod. (x5)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	2.269	2.876
2.	Treatment	9	3.683	4.669
3.	Error	18	0.788	
	Total	29		

Table.28. No. of Pod per plant (x4) Vs. Days of Maturity. (x6)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	37.50	-6.410
2.	Treatment	9	-1179.138	200.231
3.	Error	18	-5.888	
	Total	29		

Table.29. No. of Pod per plant (x4) Vs. Test Weight. (x7)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	57.281	6.982
2.	Treatment	9	-367.732	44.250
3.	Error	18	8.310	
	Total	29		

Table.30. No. of Pod per plant (x4) Vs. Yield per plant. (x8)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-37.093	-1.765
2.	Treatment	9	7169718	339.534
3.	Error	18	2.111	
	Total	29		

Table.31. No. of Seed per Pod (x5) Vs. Days to Maturity. (x6)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-o.120	9.780
2.	Treatment	9	0.570	46.362
3.	Error	18	-0.0123	
	Total	29		

Table.32. No. of Seed per pod (x5) Vs. Test Weight. (x7)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	0.0870	-21.124
2.	Treatment	9	-39.085	0.948
3.	Error	18	-0.004	
	Total	29		

Table.33. No. of Seed per pod (x5) Vs. Yield per plant. (x8) (G.M.)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-0.089	2.488
2.	Treatment	9	1.955	-54.622
3.	Error	18	-0.035	
	Total	29		

Table.34. Days to Maturity (x6) Vs. Test 100 Seed Weight. (x7) (G.M.)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	1.666	1.704
2.	Treatment	9	29.011	60.576
3.	Error	18	0.351	
	Total	29		

Table.35. Days to Maturity (x6) Vs. Test 100 Seed Weight. (x7) (G.M.)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-0.156	0.444
2.	Treatment	9	-56.082	-0.159
3.	Error	18	0.351	
	Total	29		

Table.36. Test 100 Seed Weight (x7) Vs. Yield per plant (x8) (G.M.)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	-1.479	2.791
2.	Treatment	9	28.569	-53.899
3.	Error	18	-0.530	
	Total	29		

Table.37. Yield per plant (x8) (G.M.) Vs. Yield per plant (x8) (G.M.)

S.No.	Source	D.F.	M.S.P.	F. Value.
1.	Replication	2	1.109	0.123
2.	Treatment	9	1591.878	176.972
3.	Error	18	8.995	
	Total	29		